tary *emeritus*. By his tact and energy at the time of change of government at Rome, he was enabled to save the Archives of the Academy, of which during his lifetime he was one of the most active members.

Volpicelli was well known abroad, and the Emperor of Brazil when in Rome spent some time with the professor, and conferred upon him the grade of officer of the Imperial Order of the Rose. Volpicelli travelled much, and in 1850 he made a long stay in England, where he made the acquaintance of Faraday, Brewster, Airy, Murchison, Sabine, Panizzi, Wheatstone, and others, with whom he afterwards continued to correspond. In France and Switzerland also, he was the friend of the most eminent men of science.

Volpicelli was an energetic worker in his favourite field of electrical research, and to the last maintained with vigour the theory of Melloni, at which he had worked for twenty years. The papers and other works published by Volpicelli were very numerous; no less than 270 are enumerated in a list published by the Academy dei Lincei. Although he is chiefly known by his researches in electricity, these papers show that he did much other work in various departments of mathematics and physics. Volpicelli's papers will be found mainly in the *Atti de l'Accademia dei Lincei*, and the *Comptes Rendus* of the Paris Academy. Very few of them have, however, been translated into English, a circumstance which must be regretted for the sake of English scientific men, to many of whom Volpicelli's researches are known only by name. He died calmly on April 14, having been visited shortly before his death by the Pope's brother, Cardinal Pecci.

AN AMERICAN SUGGESTION

WE have occasionally noted in these columns the formation of mathematical societies, and we have ventured, in our ignorance, to suggest that as a consequence of the great advance in the cultivation of mathematics recently made by our American cousins, the time had come for the formation of an American or (following the analogy of associations nearer home) of a Baltimore Mathematical Society.

A short account of the *Proceedings* at the fifth meeting of the Lehigh Mathematical Society—recorded in the *Bethlehem Daily Times* (Pa.) for March 17—may interest kindred societies on this side the Atlantic, and serve to show that the transactions of such learned bodies may contain "something of importance and profitable (*sic*) to the general reader."

It appears that in order to remedy the defects in the art of surveying, it has been made imperative (so says Mr. S. R. Vay, Civil Engineer, the reader of the paper[1]) by the American legislature that "each county should at its own expense and on its own land, plant, or erect, two monuments of stone, so that the straight line between them should be an exact and due meridian, or north and south line; in order that thereby surveyors, by setting a compass on the one monument, and pointing it to the other, might readily ascertain the deviation or variation of the magnetic needle, and thus be prevented from committing errors in the determination of property lines and landmarks." His soul was much stirred at the neglect of this "scientific duty." It seemed to him that "the scientists of the valley ought to urge, with no uncertain voice, the erection of such or similar monuments. With but little extra expense they could easily be made to interest and to educate, as well as to serve the purpose designed by the legislature. Imagine, for instance, two beautiful granite monuments standing in appropriate situations on the spacious ground of Lehigh University, one mounted with a sun-dial, and the other with an anemometer. On one of them should be cut in plain letters the latitude, longitude, and elevation above the sea of that exact spot. On the other should be recorded a statement of the mean annual temperature and rainfall of the valley. The axis of the sun-dial would not only point to the steadfast pole, but be parallel to the earth's axis; it could, indeed, be furnished with a hoop or circle, to represent the equator, and with others to represent the meridians of Greenwich, Washington, and Bethlehem; a circle to indicate the ecliptic would not be difficult to add, which, by properly constructed clock-work should be always kept parallel to the real ecliptic itself. Thus all who might pass that way would be interested in reading the inscriptions and observing the time, and many would be instructed in the science of astronomy. Even to students it would be of benefit in lightening their mental struggles to grasp, conceive, and understand the idea of the ecliptic circle and the ecliptic plane."

In the discussion which followed, the President doubted the wisdom of the legislature, and thought the better way would be to require higher qualifications from surveyors.

Dr. H. E. Licks inquired the expense of such a sun-dial as Mr. Vay had described.

Mr. A. S. Tronomy said "it was usual to consider the ecliptic as a fixed plane when illustrating the yearly motion of the earth. When considering the daily rotation, however, he could see that Mr. Vay's plan had some advantage."

The next paper was by Prof. Ternion, "On the consequences which would result from denying or reversing the tenth axiom of Euclid." The argument, we learn, was "elaborate and profound, being exemplified by long formulas written on the blackboard." He showed that "if the properties of matter or space were such that the axiom became false, a knot could not be tied in a string, that a hollow rubber ball could be turned inside out without tearing or stretching, and that no satisfactory system of paper or silver money could be employed."

Mr. K. M. Puter considered the paper as an example of mathematical analysis, one of very great value, but he considered it fortunate that we cannot practically reverse the axioms of geometry. "If we could, the results would be disastrous." Our notice of the *Proceedings* at this interesting meeting have extended to some length, but they may be suggestive of matter for societies on this side of the world. We cannot close, without alluding to another feature, and that is the subsequent proceedings (unscientific) before the members separated.

Crackers and cheese were brought forward and the knot untied by the Secretary "without denying any axiom whatever." "The mathematical joke and the hearty laugh were heard," and, tell it not in Gath, they sang a song. Of a Mathematical Society not a hundred miles off, the first President wrote, "not a drop of liquor is seen at our meetings, except a decanter of water; all our heavy is a fermentation of symbols; and we do not draw it mild. There is no penny fine for reticence or occult science; and as to a song! not the ghost of a chance."

THE STANDING STONES OF CALLANISH

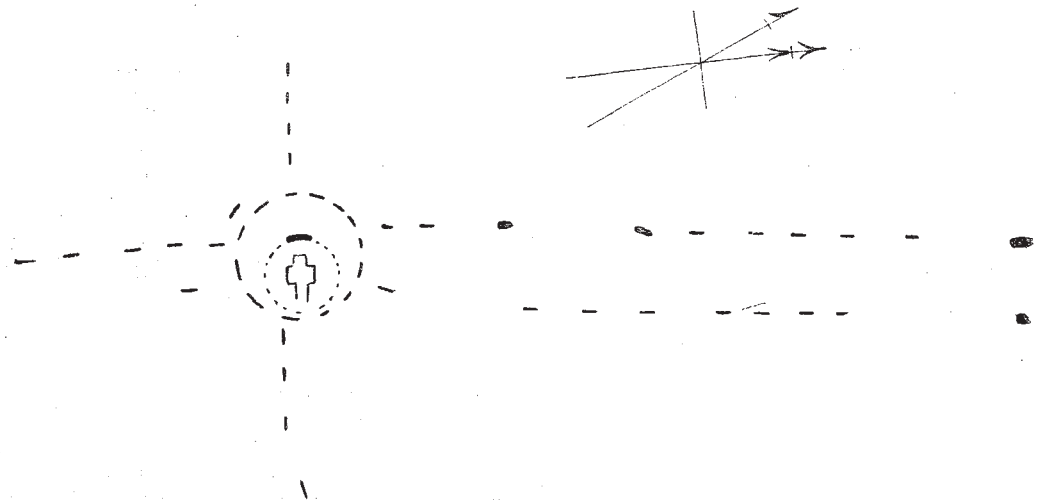
THE object of the present paper is to describe the standing stones of Callanish, Island of Lewis, accompanied by notes of such measurements as the author was able to take during a somewhat hurried visit to these very interesting memorials of the early inhabitants of our islands.

Leaving the town of Stornoway, we soon find ourselves amongst great tracts of moorland, with sheets of water large and small on all sides. The deep black peat is being cut and piled up into stacks, when, after being dried, it will serve for the winter's fuel. The peats in the Lewis

[1] Touching first upon the necessity of preserving boundaries and upon the methods employed by the ancients; tracing the word geometry to its source, and relating how the Egyptians were puzzled to find their landmarks, he then passed on to the discovery of the magnetic needle, and the perplexity caused to country surveyors by the deflection of the same.

are broad and thin, and not so brick-shaped as those on the mainland further south. All around wears a sombre aspect. Miles and miles of bog and moorland, without tree or bush to break the long undulatory lines which rise and fall like the waves of the sea.

At length, as we reach the top of a slight rise, we see before us the object of our visit, the stones appearing so thickly clustered together on the rising ground on which they stand, as to suggest the likeness to a cemetery. Leaving the vehicle a little beyond the sixteenth mile-



Plan of General Arrangement of Group.

stone from Stornoway, we ascend by a roughly causewayed roadway which leads from the main road to the top of the low hill upon which the stones are placed. On a closer inspection it is found that the general outline is cruciform, and at or near the intersection of the cross limbs is placed the largest stone, whilst around is a circle of tall stones. The stones are rough, and appear only to have received such dressing as would bring them to a suitable shape for erection; they are composed of the rock of the island, the Laurentian gneiss, which, in geo-

View from North-East.

logical record, is the oldest known. In colour it is greyish, with occasional flesh-coloured patches. The stones are monoliths, and are all upright.

The upper parts of the stones are covered with a greyish green lichen, the lower parts being comparatively bare. This is accounted for by the fact that a number of years ago the proprietor of the island caused the peaty ground around to be removed, which showed that the height was much greater than had at first appeared; the parts thus recently disclosed have not the heavy coating of lichen which the upper parts have; the line separating the two parts is very marked. From this the great age

of the stones may be inferred, as there has been an accumulation of peaty soil of about five feet deep.[1]

From a careful inspection of the stones the author found the number to be forty-eight. (The driver's remark on being asked the number was that they could not be counted over by different people and made the same.) The highest stone is about 16 feet, and the stones forming the circle are next to the central one in height, varying from about 8 feet to 11 feet. The others vary from about 7 feet to about 4 feet.

The longer limb of the cross is composed of two rows of stones placed about 27 feet apart, there being ten stones on the west side and nine on the east side. This is a very distinct feature in the arrangement, as there is thus an avenue leading to the circle. The circle consists of thirteen stones, and the western and eastern cross arms have each a single line of four stones, whilst the southern limb is composed of six stones; the whole with the central stone and one outside and close to the circle makes forty-eight. The general arrangement will be more readily understood from the accompanying plan, which is drawn approximately to scale. From careful observations with a pocket compass, the general bearing of the northern limb was found to be 30° to east of magnetic north; it was also found that, when a line was projected from the flat side of the endmost southern stone, it cut exactly the end stone of the western side of the northern limb; the latter stone measures about 11 feet in height. If the compass variation be estimated at 25° west (the latitude is about 58° 12′ north), it appears that the main axis of the group lies about 5° to *east* of true or polar north. Several of the stones besides the one already mentioned appear to have a *directive* tendency, notably the one next the circle in the eastern side of the northern limb; this stone, both from its pointed shape and flat form, leads the eye to the centre of the circle. The whole series, indeed, are arranged with their narrow faces pointing in the line of setting; this is easily noticed, as the stones are generally flat, thin, and slab-like. The circle stones have their broadest faces turned to the centre of the circle. The great stone is situated at or near the centre of the circle; it measures about 16 feet in height, with a breadth at bottom of 5 feet, at middle of 4 feet, and upper part 3 feet 6 inches; its thickness is 1 foot; its flat side faces the east. This stone must weigh about six tons.

The general dimensions of the group are as follows :—

Extreme length, 128 yards; length of northern limb, 85 yards; diameter of circle, 14 yards (this measurement is in a north and south line; from east to west the measurements gave 13 yards, so that the figure is slightly elliptical); length of southern limb, 29 yards; extreme breadth, 44 yards; length of western arm, 13 yards; length of eastern arm, 18 yards. The whole figure roughly resembles the Iona cross in outline. In or near the centre of the circle there is a hollow, roughly rectangular on plan, measuring about 7 feet long, the breadth at centre being 6 feet, and at ends 5 feet, narrowing, however, at the eastern end, so as to form a kind of channel leading outwards. The sides of this hollow are built of small stones, and four large stones are placed so as to break up the whole into two chambers. The direction of length of this hollow is east and west; the tall central stone already described being situated near to and facing its western end. It is said that a stone cover was found upon this hollow when first discovered. The hill upon which the stones are placed slopes downwards to the north; the ground on which the cross arms are placed is about level.

[1] It is difficult to get reliable data as to the growth of peat-moss, but taking about 200 years to the foot, a depth of 5 feet would infer a period of about 1,000 years since the peat commenced to form. In Black's "Guide" it is stated that the stones rest on a causewayed base. As there was no trace of this at the time of the author's visit, seeing that there was a vegetable growth all around, some data as to rate of growth of the peaty soil might be got, as it is about twenty years since the excavation of the peat took place.

Another circle of tall stones still stands about a mile to eastward, from which it appears that the peat has been recently removed.

From an examination of the stone circles of Arran, the late Dr. Bryce found that stone cists in some cases existed at the centres of the circles, and that the longer lengths of these cists, as also the longer axis of one elliptically-shaped series of stones, were all lying about north and south, or inclining rather to east of north.

In the Smithsonian Report for 1876 there is a description of mounds and lines of stones in Guatemala, the long sides and directions of which were about 5° to west of magnetic north; they vary from 2 feet to 6 feet in height. This would leave, after allowing for the easterly variation of the compass there, a probable direction of 5° or 10° to east of true or polar north. A certain similarity, therefore, appears to exist in the setting out of these groups, with a tendency to a direction east of north.

The country people called the place Callanish, not Callernish, as sometimes given, the meaning of the former name having been defined as "place of assembly for worship," whilst the latter is given as "bleak headland."[2] The title Fir Bhreige, or false men, is sometimes given to the group, from the apparent motion of the stones as the spectator changes his position when viewing them from a distance.

The erection of such circles as that of Callanish has been popularly attributed to the Druids, and according to this theory the Callanish circle would have been a religious meeting-place. Again, it has been supposed that they were tombs of warriors, and may have been erected by the early Norse rovers. Others look upon such groups of stones as places for judicial meetings, which might have been accompanied by religious ceremonies. From some recent scientific investigations at Stonehenge it appears likely that the stones there were erected for astronomical purposes.

The general impression which one gets from standing amongst the Callanish stones is that the long avenue was intended as an approach from the not far distant shore for a large body of people, who would thus converge towards the central circle. W. J. MILLAR

OUR ASTRONOMICAL COLUMN

BIELA'S COMET IN 1879.—There have been suggestions as to sweeping ephemerides for the recovery of one or other portion of the disintegrated comet of Biela in the present year. It is not, however, easy to decide in what manner, or rather upon what assumptions, calculation can be brought to bear with the greatest chance of success. We know that in 1852 the observed positions of the two nuclei were such that they could be accurately connected with similar positions at the preceding appearance in 1846, by the application of the perturbations from known causes in the interim, and it is also certain that neither of the nuclei was in the calculated position at the next return but one in 1866, there having been no chance of finding the comet in 1859, from proximity of its geocentric track to the sun's place. In 1865-6 the comet was diligently sought for in and around the position it should have occupied by the elements of 1852, brought up to 1866 by the application of planetary perturbations during the two revolutions, with some of the most powerful instruments in our observatories, including the refractors at Pulkowa and Copenhagen. D'Arrest, after long search, was convinced that the comet, speaking collectively, could not have passed its perihelion within many days of the time predicted. The conclusion was inevitable that perturbation from some unknown cause must have taken place between 1852 and 1866, and that all clue to the future movement of the comet was for the time lost. In 1872 endeavours to find

[2] See Smith's "Lewsiana."